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FINGERPRINT VERIFICATION USING QUALITATIVE RECKON TO RAISE THE EFFECTUALNESS

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ABSTRACT

Biometrics is the currently topic infused in today's technology at high attention. With identity frauds in the society, one's unique id is must to keep. Here, a proposed work on fingerprint images using neural networks and fuzzy logic is integrated to enhance the effectualness of the system in naive bayes classifiers. Qualtitave reckon methods are so used as they provide the knowldege and act as result providers in the proposed work. The fingerprint matching is done with neural networks and in naive bayes and the result proves the better use of neural networks. The proposed work using neural networks proves enhancing of the inputs than the existing approaches.

KEYWORDS: Fingerprint Images, Fingerprint Minutiae Matching, Fuzzification, Naive Bayes Classifiers, Neural Networks

INTRODUCTION

Biometrics refers to characteristics of human's behaviour. Biometrics identification or authentication is used as a form of the access for accurate and reliable identity of a trusted and untrusted user. Fingerprint identification is must as it helps in identifying the unauthorized user or the culprit in civilian applications. The verification of a matched source is done using naive bayes classifiers and also with neural networks. A naive bayes is an indepent feature model. Depending on the probability model, it is `efficient in supervised learning setting. Neural networks along with fuzzy logic is used as an information list to analyze.It is configured through a learning process.

Minutiae Matcher

The basic concept for minutiae matcher is to take a reference point or line then decide the origin for the co-ordinates and now translate and rotate the whole image to have an image. Combination of patterns called ridges and valleys develop the fingerprints. Single arched section is known the ridges whereas part between two adjoining ridges is known as valley and ridge termination is known as minutiae.

Artificial Neural Network(ANN)

An Artificial Neural Network (ANN) is an information processing system inspired by the way biological nervous systems, such as the brain, process information. An artificial neuron has many inputs and one output. The neuron has two modes of operation : Training mode, the neuron can be trained to fire (or not), for input patterns. In the using mode, when a taught input pattern is detected at the input, it results to the current output..

Naive Bayes

A Bayes classifier is a simple probabilistic classifier based on applying bayes' theorem from bayesian statistics with

strong (naive) independence assumptions. An arbitrary number of independent variables whether arranged in continuous or categorical manner. Given a set of variables X = {x1, x2, x...,xd}, we want to construct the posterior probability for the event Cj among a set of possible outcomes C = {c1,c2,c...,cd}. In a familiar language, X is the predictors and C is the set of categorical levels present in the dependent variable. Using Bayes' rule:

$$P(Cj / x1,x2\ldots\ldots xn) \text{---- } p(x1,x2\ldots..xn/Cj)p(Cj)$$

Where, p(Cj | x1,x2,x...,xn) = posterior probability of class membership, i.e., the probability that X belongs to Cj. Since naive bayes assumes that the conditional probabilities of the independent variables are statistically independent we can decompose the likelihood to a product of terms:Using bayes' rule above, we label a new case X with a class level Cj that achieves the highest posterior probability.Although the assumption that the predictor (independent) variables are independent is not always accurate, it does simplify the classification task dramatically since it allows the class conditional densities p (xk Cj) to be calculated separately for each variable, i.e.,reducing a multidimensional task to a number of one-dimensional ones.

Fuzzification and Defuzzication

In fuzzification, the two input variables are antecedents and output variable is used as the consequence in the fuzzy control. It is methodology that lends itself to implementation in systems ranging from small embedded micro-controllers to large control systems. Defuzzification is the process of producing a quantify result in fuzzy logic on the basis of fuzzy sets and corresponding membership degrees. It is needed in fuzzy control systems and a number of rules that transform a number of variables into a fuzzy result described in terms of membership in fuzzy sets.

PROPOSED WORK

To develop an algorithm that can accurately recognize the fingerprints and then performs the effective matching. The fingerprints consist of minutiae's, so it is very difficult to match the minutiae of one finger with other. To compare the proposed algorithm effectively resulting the output than the existing algorithm,compare the performance of both the algorithms in term of two metrics-FMR, FNMR. The current fingerprint paradigm needs to data-mined and then refined. New empirical research should lead to improved match criteria and give us further confidence in the reliability of match or non-match decisions. Therefore more robust image enhancement algorithm on fingerprint images like naive bayes using neural network and fuzzy logic and it would be compared to produce more flexible system. The reliability of a matching criteria is measured in terms of following two factors:

- **False Matching Ratio:** It is the probability that the system decide to allow access to an (FMR) imposter is given in an equation.

$$FMR(\text{false match rate}) = \frac{\text{False Matches}}{\text{Imposter Attempts}}$$

- **False Non Matching Ratio (FNMR):** It is the probability that the system denies access to an approved user is given in an equation.

$$FNMR(\text{false non-match rate}) = \frac{\text{False Non Matches}}{\text{Enroll attempts}}$$

These ratio of existing algorithms can be improved by our proposed algorithm. The verification for a matched status is done by using naive bayes and neural networks. The fuzzy set helps in enhancing an optimal solution for true match or false match.

PROGRESSION

- **Training Part**

  STEP I Start

  STEP II Upload an image from the images file

  STEP III Binarize the image

  STEP IV Find out region of interest,then thining is done

  STEP V Feature extraction(minutiae points)

  STEP VI Remove false minutiae

  STEP VII Save to fingerprint database

- **Testing Part**

  STEP VIII Upload test data

  STEP IX Repeat from step II

  STEP X Implement neural network

  STEP XI Implement NAIVE BAYES

  STEP XII Match and Non match checking

  STEP XIII Check efficiency at different angles

  STEP XIV Results.

Flowchart of the Progression

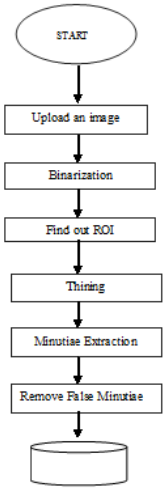

Figure 1: Flowchart of the Training Module

After the problem is formulated, data is to be processed in MATLAB 7.10. This is an user interface and provides easy ways to implement. Aneuron may have hidden layers which helps the other neurons to interact indepent or with coperation. The image of the fingerprint goes under sub-modules like thinig, rotation on specified angles,saving to the database FVC, nd enhancing the result with comparison of neural networks and naive bayes. The neural network works along with fuzzy sets for improving the representation using learning process. The neural network saves the results in the database and present the accurate values of matched or not with the no of image saved in the database.

Flowchart of the Testing Module

The flowchart of the testing module is the next step to the training part. It tests for the matches images from the fingerprint image to the images stored in the fingerprint verification database.

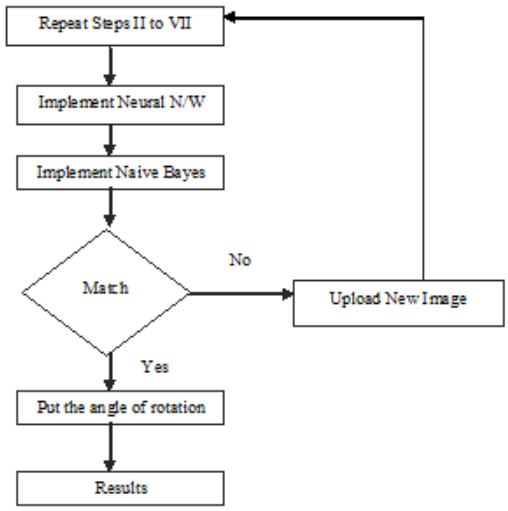

Figure 2

EXPERIMENTAL SET-UP

Hardware Required

To conduct the working of the fingerprint verification, MATLAB used is MATLAB 7.10.0.It requires 32 bit operating system on Windows XP/Vista.

System Design

In the first stage, image acquisition of fingerprint image is done. In the second stage,binarisation of fingerprints image is done. In the third stage, thining of the fingerprint image is performed. In the fourth step minutiae extraction is done to get the features. In the fifth stage, removal of false minutiae is done. In the sixth stage implementation of Fuzzy logic with NN and bayes classifier is done separately to have the comparative results. Finally in the seventh stage ,accuracy comparison of both the classifier is done.

Binarization of Image

Binarization is the initial step for the fingerprint matching of the chosen image with the image in the database. It is done to highlight the foreground pattern from the background. It is the process of conversion of grayscale image into binary image. 1 value is given to the foreground pattern so that its visibility can be increased whereas 0 value is given to background

to make the visibility zero.

ROI (Region of Interest)

This is a segmentation technique. The main motive of the segmentation is to make the image simpler which can be representing very easily and to make image meaningful that will be easy to analyze. Generally ROI (region of interest) is the subset of the image.

Thining Morphological Operation

Thining is the thickness reducing process which effectively thins the fingerprint. Thining reduces the size of blueprint till the breadth of stroke becomes single pixel and while the applying process some precautions has to be taken such as:

- Thining of ridges should be done to its innermost pixel

Noise removal has been done effectively.Thining is the subtraction of input image.Mathematically it is shown as :

$$X ? Y = X - X(X ? Y) = X \cap (X ? Y)$$

Remove False Minutia

Removing of false minutia is a very important step of the pre-processsing. Presence of large number of false minutia will led to the wrong fingerprint matching. False minutia removal has been taken place distinctively if following order to get the accuracy.

Flowchart of the System Design

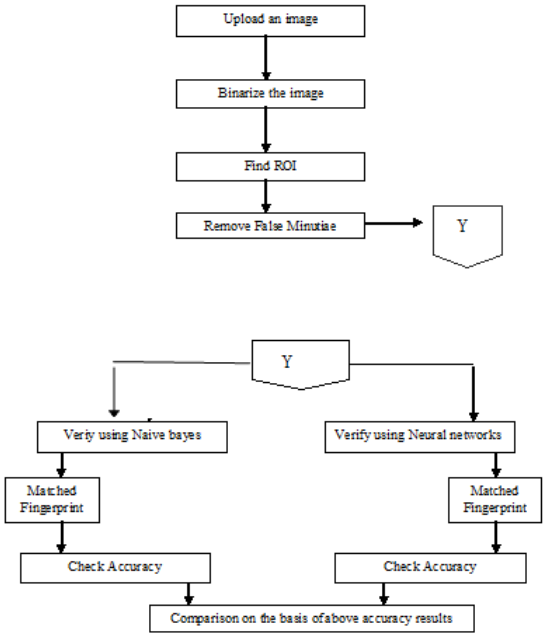

Figure 3

RESULTS

Results on the Basis of System Design: Table and Figure of Average System Design

Table 1: Average System Design

S. No.	Angle of Rotation(in Degrees)	Neural Network	Naive Bayes
1	65	93.15	90.70
2	15	90.69	85.68
3	-15	87.50	87.28
4	75	93.61	91.75
5	-40	92.33	91.34
6	28	88.14	86.25
7	90	92.20	85.99
8	-35	91.41	88.79
9	40	85.87	89.42
10	38	87.50	86.82

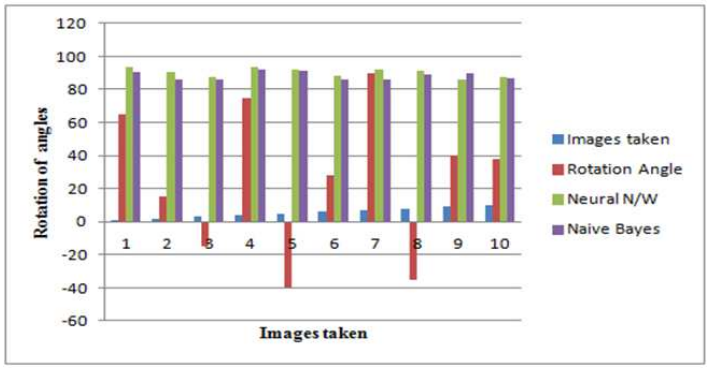

Figure 4: Average System Design

Results on the Basis of Average Time of Neural Network and Naive Bayes: Table and Figure of Average Time Taken

Table 2: Average Time Comparison

S. No.	Angle of Rotation (in degrees)	Time (ms) Neural Network	Time(ms) Naive Bayes
1	**5**	**11.15**	**18.42**
2	**10**	**12.12**	**21.17**
3	**15**	**14.19**	**19.24**
4	**20**	**15.01**	**21.12**
5	**25**	**10.15**	**20.03**
6	**30**	**11.34**	**17.50**
7	**35**	**13.21**	**19.25**
8	**-5**	**13.76**	**21.25**
9	**0**	**14.12**	**20.13**

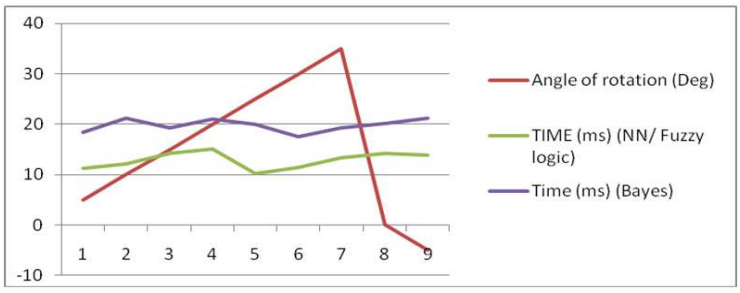

Figure 5: Average Time Comparison

Results on the Basis of Accuracy

Table 3: Accuracy of the Both Systems

S. No.	Angles of Rotation(in Degrees)	Accuracy(Neural Network)	Accuracy(Naive Bayes)
1	0	95	76
2	5	93	78
3	10	94	75
4	15	94	79
5	20	93	75
6	25	95	77
7	30	94	78
8	35	95	80
9	40	95	81
10	-5	95	78

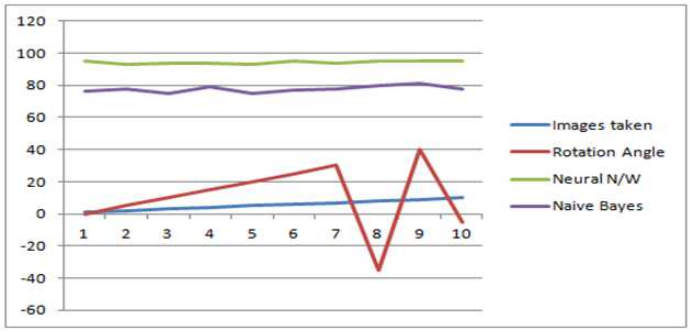

Figure 6: Showing Accuracy in Both the Systems

The results obtained from the simulations are analyzed and neural works better with upto 95% whereas naive bayes work near to 82%.

CONCLUSIONS

- NN/ Fuzzy logic method matches the extracted minutiae point on the basis of epochs provided to the classifier. The classifier works with the hidden layers. Suppose if the provided hidden layer is ten, the system would be evaluated for 200 times if the epoch count is 20. In each and every iteration, the value of threshold to be applied is reduced to an level to check the accuracy of the classification. It gives above 94%.
- The NN/ Fuzzy logic classifier is one of the most suitable algorithms to check the finger print matching with angle variations.The system has been tested with several angles like -20 , -40 , 50 , 70 , 90 degrees of rotation. With every angle of rotation, NN/FL has shown a signification improvement in the classification accuracy in comparison to the bayes, hence it can be concluded that NN/ FUZZY LOGIC works more efficiently in rough conditions.

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